Amendments to the Specification

Please replace the fourth paragraph on page 9, lines 17-22 with the following amended paragraph:

Monolithic adsorbers can be characterised by several structural parameters related to the physical form of the monolith and the inherent pore structure of the material comprising the monolith walls. The macrostructure of the monolith is defined by the cell size, C, and the wall thickness, t (see ~~figure 9~~ Figure 7). The pore structure of the walls is defined by the macropore size and pore volume and the micropore size and micropore volume.

Please replace the third paragraph on page 12, line 25 - page 13, line 9 with the following amended paragraph:

Referring to ~~fig~~. Fig. 1 the adsorber system must be designed to cope with the inherent breakthrough characteristics of the adsorbers and typical breakthrough curves for adsorbers are shown. Curve A, for a typical granular adsorbent, shows a sharp rise in effluent concentration with a time to half inlet concentration of $T_{0.5}$. However the adsorption process must actually be stopped after time $T_{B\text{-gran}}$ when the effluent concentration reaches the legal effluent limit. The dynamic adsorption capacity is then defined as $(C_I\text{-}C_B) \times T_{B\text{-gran}}$. In the case, of monolithic adsorbers the breakthrough characteristics are always inferior to fixed beds, as is inevitable for a low pressure drop system, and is as shown in curve B. The time to breakthrough has now decreased to $T_{B\text{-mon}}$ and the dynamic adsorption capacity is now significantly lower even for carbons

with equivalent equilibrium capacities. The nature of the breakthrough curve for the monolithic adsorbers is strongly dependent upon the length of the monoliths. We have found that a minimum length of lm is required to give reasonable breakthrough properties. The use of longer monoliths will increase the dynamic capacity but may reduce the overall cost effectiveness.

Please replace the first paragraph on page 14, lines 3-11, with the following amended paragraph:

Theoretical studies have shown that, provided the performance of the monolith is not controlled by diffusional limitations within the wall structure of the monolith, then referring to ~~fig~~. Fig. 7 the optimum structure is a cell size, c, of approximately 150 microns, with a wall thickness of approximately 150 microns, equivalent. With this cell structure the monolith gives equivalent dynamic performance to a granular carbon with a particle size of 300 microns but without the problems of pressure drop and attrition etc associated with the operation of granular beds. A critical aspect of the technology is then the ability to produce pure, electrically conducting, carbon monoliths with these controlled cell structures.

Please replace the second paragraph on page 15, lines 13-15 with the following amended paragraph:

The configuration of a reactor is shown schematically in ~~figure~~ Figure 2. This shows a configuration with 4 monoliths connected in series (A, B, C and D) and three banks of these connected in parallel.

Please replace the third paragraph on page 15, lines 17-20 with the following amended paragraph:

In this configuration there are 6 parallel gas pathways. The alternative configuration, shown in ~~figure~~ Figure 3, has the same resistance as the reactor shown in ~~figure~~ Figure 1 as it still has 4 monoliths in series and 3 banks of 4 monoliths in parallel but has a higher linear gas velocity as the feed passes through 3 monoliths in parallel, not 6.

Please replace the first paragraph on page 16, lines 5-14 with the following amended paragraph:

To achieve this design it is necessary to be able to make simple electrical connections at each extreme end of the monoliths (A) and gas tight electrical connections at the joints between monoliths (B). We have now found that these connections can be readily made using a combination of electrically conducting metal mesh sold by Warth International under the trade name of "Mesh Wrap" and "shrink wrap" plastic tubing, for instance "Flame Retardant Heat Shrink RP4800" sold by Raychem, that has been selected to be stable at the regeneration operating temperature of the reactor. The two types of connection, end and joint are shown schemically in ~~figure~~ Figures 4a and 4b where (1) is the monolith, (2) is a shrink wrap plastic, (3) is the metal mesh connector and (4) is the electrical contact (~~fig.~~ Fig. 4b)

Please replace the second paragraph on page 16, lines 18-28 with the following amended paragraph:

The second requirement for the construction of a viable reactor are leak tight gas interconnections. The general reactor requirement is shown in ~~figure~~ Figure 5 for the absorption ~~fig~~. Fig. 5a and regeneration ~~fig.~~ Fig. 5b cycles. The reactor looks like a conventional floating head heat exchanger. The monoliths (6) are sealed into a plate (7) that is in turn sealed into the reactor body. The head seals are shown in the next diagram. Further along the reactor are two or more location plates (8). These are not sealed to the reactor body or to the monoliths and serve simply to prevent the monoliths moving and touching which could cause an electrical short. Gases can pass these plates either around the monoliths or between the plates and the reactor walls. There is gas regeneration outlet (9), regeneration inlet (10), inlet and outlet values (11) and (12).

Please replace the third paragraph on page 16, line 30 - page 17, line 17 with the following amended paragraph:

The reactor head assembly can be seen in ~~figure~~ Figure 6. This comprises the reactor head (14) with the inlet flap valve (15) and the main reactor body (16). The carbon monoliths are sealed into the reactor by a two part plat assembly (17). The monoliths are held in the two part plate assembly by the O-ring seals (18) where the O-rings are located in a either a chamfered or recessed groove in one of the plates. When the plate assembly is compressed between the head (14) and the body (16) the groove on one plate forces the O-rings against the upper and lower plates and the monoliths providing an effective seal against gas leakage out of the reactor between the plates and past the monoliths into the

reactor body. The whole head assembly is also sealed between the head and body of the reactor by the head gaskets (19) and the body gaskets (30). The O-rings are selected from a polymer that is capable of operating at the required regeneration temperature eg Viton, Kalrez (RTM) etc. The head and body gaskets can be beneficially produced from any flexible, compressible gasket material such as rubberised cork or flexible PTFE gasket material. The design of the reactor system minimises the temperature that these gaskets are exposed to as the walls of the containment vessel are partially cooled by the incoming purge gas. This method of assembly also makes it easy to remove and replace monolith elements should any get damaged.

Please replace the second paragraph on page 17, lines 21-22 with the following amended paragraph:

Operation of this reactor assembly follows the following stages by reference to ~~figure~~ Figure 5.

Please replace the third paragraph on page 17, line 25 - page 18, line 7 with the following amended paragraph:

During adsorption the main inlet (11) and outlet (12) are open with the VOC laden gas passing through the monolith channels from (11) to (12). The regeneration inlet, (10), and outlet, (9), are closed. Typical adsorption gas flows can range from 0.5 L/min per parallel monolith pathway to 25L per parallel monolith pathway depending on the VOC concentration and the overall process design. In conventional adsorption systems, where the large beds have a high thermal capacity, it is necessary to go through an initial bed

cooling stage in clean gas immediately following the regeneration stage and prior to adsorption as the adsorption efficiency of the hot beds is very low. Surprisingly we have found that this intermediate cooling step is no longer necessary in the monolithic reactors. Due to the low ~~thennal~~ thermal capacity of the monolithic beds they can be cooled back sufficiently quickly to the normal adsorption temperatures simply using the incoming feed gases without any adverse effect on the overall adsorption cycle.

Please replace the first paragraph on page 19, lines 1-5 with the following amended paragraph:

However we have found that the frequently observed "poor" performance of monolith adsorbers can often be associated with a characteristic of the monolithic reactors we have termed "leakage". This is a low level of VOC's that exits the bed almost immediately the feed is introduced and well before the normal breakthrough (see ~~figure~~ Figure 8).

Please replace the second paragraph on page 19, lines 7-18 with the following amended paragraph:

We have found that this "leakage" is a complex function of the feed VOC concentration and the linear velocity in the bed. These characteristics dictate the optimum bed design for systems where such leakage cannot be tolerated. These effects are shown in ~~fig.~~ Fig. 9 where the plateau value of the leakage is shown as a series of contours as a function of feed linear velocity and feed VOC concentration. The net effect is that for minimum leakage the monolithic reactors must be operated at low linear velocity. The maximum usable velocity for zero leakage is then a function of the feed concentration. With the

monolith reactors this can be readily achieved by operating with the majority of the monoliths in parallel as shown in ~~figure~~ Figure 2 rather than in series as shown in ~~figure~~ Figure 3. This "shallow" bed arrangement is readily achieved with the monolith adsorbers whereas in a conventional granular bed such shallow beds can lead to channelling and bed bypassing.

Please replace the third paragraph on page 19, lines 20-23 with the following amended paragraph:

We have also surprisingly shown that the leakage can be further reduced by using multiple shorter lengths of monolith (31) and further reduced if the multiple short lengths of monolith are separated by small spaced (32) but where the overall monolith length in both cases remains unaltered as shown in ~~figure~~ Figure 10.

Please replace the first paragraph on page 20, lines 1-5 with the following amended paragraph:

Referring to ~~fig~~. Fig. 11 two monolith beds (41) and (42) made of monolithic carbon beds are arranged as shown. An electric current can be applied across monolith (42) from (IV). Feed gas (F) comprising air contaminated with VOCs enters the top of monolith bed (41) and exists as VOC free air from the bottom (P). Flow is stopped when the VOC concentration in the effluent air stream reaches the legal limit.

Please replace the first paragraph on page 21, lines 1-10 with the following amended paragraphs:

In some circumstances this could be achieved just with water cooling although some refrigeration may be required depending on the VOC's being recovered and the ambient conditions. The VOC saturated regenerant gas stream (E3) from the chiller ~~(E3)~~ 44 then passes back to the feed stream, (F). Due to the low regenerant gas flows required in this system the additional load on the adsorber due to stream (E3) is minimised. This is only possible with the electrically heated monoliths where large regenerant gas flows to carry the heat to the reactor are not required. The performance of these extended length monolith systems can be further improved by incorporating flow mixing devices in the spaces between the monoliths.

Please replace the second paragraph on page 21, lines 14-17 with the following amended paragraphs:

Referring to ~~fig~~. Fig. 12 a significant improvement in performance can be achieved by introducing ~~a~~ small granular carbon beds (51), (52) into the flow pathway of the two bed systems of ~~fig~~. Fig. 11. This granular bed comprises granular carbon of particle size and has a volume which is 10% of the volume of bed.

Please replace the third paragraph on page 21, lines 19-28 with the following amended paragraphs:

This can be used in conjunction with the extended monolith two bed systems or the three bed systems, but will demonstrate maximum benefits when using a two reactor, short monolith system illustrated. The benefit arises from the improved breakthrough characteristics of the granular bed, as shown in ~~fig~~. Fig. 1 However by only using this to

polish the effluent from the monolith bed the volume of granular carbon and the pressure drop introduced is minimised. The problems inherent in heating granular beds are also eliminated as the monolith bed is now used as a preheater for the granular bed. Furthermore by positioning the granular bed at the outlet of the monolith bed and then regenerating in counter current flow mode, the granular bed sees clean regenerant gas which facilitates cleaning at minimum temperature.